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ABSTRACT

This research, proposing that the teacher is the pivotal component between the student receiving a mediocre science education or a dynamic science education, was designed to observe and to analyze the science teaching strategies and methods of recognized, exemplary, fifth-grade teachers. Six teachers from six different public schools in two adjacent East Tennessee county school systems were observed six times each. The sites represented a broad spectrum of the socioeconomic status of the communities in which they were located. Three of the observations were of science classes, three of another subject chosen by the teacher. Teachers also answered a questionnaire and were interviewed. Analysis of the data found that exemplary elementary teachers who did not prefer to teach science exhibited characteristics that reflected their anxiety in subject area knowledge which impeded their ability to teach effectively. The science lesson became secondary to the minutiae mandated by the textbook, instruction focused on the teacher, and the teacher held tight control over the students' behavior. The teachers who preferred to teach science exhibited characteristics that reflected their confidence in both their subject area knowledge and their pedagogical expertise. Their science lessons relied heavily on manipulatives, laboratory experiments, and connections with the students' actual lives. (Contains 11 references.) (JB)

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Methods and Strategies of Exemplary Fifth Grade Teachers: Science As Preferred and Non-Preferred Subject

by

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Methods and Strategies of Exemplary Elementary Teachers:

Science as Preferred and Non-Preferred Subject

This study examines a population from which little serious research has been undertaken - - the exemplary, elementary science teacher. Exemplary teachers, such as the sample of teachers included in this research, are a unique population that traditionally has been considered difficult to identify objectively. Excuses for this identification and classification perplexity have included (a) student population variations, (b) discrepancies in site funding, and (c) societal subgroup expectations of "success." The results of these defensive rationalizations by the educational community has impeded research from being conducted on the exemplary teacher. This research proposes that the teacher is the pivotal component between the student receiving a mediocre science education or a dynamic science education and was designed to observe and to analyze the science teaching strategies and methods of recognized, exemplary, fifth grade teachers.

Review of the Literature

Exemplary school programs have been studied extensively over the last two decades. Paradoxically, the exemplary teacher has all but been ignored in similar research - - both quantitative and qualitative. Collinson (1993) states that limited research in this area has yielded a bare-bones, though consistent description of professionals who are curious, caring, and committed to their chosen occupation.

History of Science Education

The last major subject to be included in the elementary curriculum, science has often assumed a stepchild status among elementary educators. Victor (1975) states that the first science curriculum for elementary age children, a nature study, was introduced into a few scattered schools in the late 1800's. Fortunately, for the students in the earliest programs the original instructors were both specialists in science and master teachers who could provide a dynamic and unforgettable learning experience for the children. Unfortunately for the students who followed, the science curriculum was thrust upon many teachers who had little, if any, science background. Possibly due to insecurity, these inexperienced science teachers began to place undo emphasis on definition, identification, classification, and other incidental details. Often the obscure details "assumed increasing importance and eventually became *the end*, rather than the means to an end. Learning activities involving firsthand observation gave way to reading about nature in books." (p. 5)

Regrettably, this dispassionate attitude persists even today. The teacher who finds fifteen minutes of unstructured time at the end of a harried day and reluctantly commands, "Class, open your science books to page . . . " is continuing the heritage of the unprepared, anxiety filled educators of the last century. Sadly, those original science *textbooks* of the nineteenth century have simply been replaced in today's classrooms by a current edition. The emphasis is still too often on the incidental details, not on the concepts of science.

Elementary Science Teachers

The more than 1.3 million elementary teachers currently educate more than 20 million students below the high school level (United States Department of Education, 1992). These elementary educators have very homogenous characteristics. Weiss (1987) reported that in grades

K-3, 82% of the teachers are white and 94% are female, and in grades 4-6, 86% of the teachers are white and 76% are female. In a similar study Espinet, Simmons, and Atwater (1992) found that the typical elementary teacher (a) is married, (b) had completed hours beyond the Bachelor's Degree, (c) had initially been influenced to become a teacher by her/his mother or an elementary teacher, and (d) experienced dissatisfaction with her/his profession. Based on this data the typical elementary school teacher is a well educated, married, white female who would rather not be teaching!

Unlike their colleagues in high school, elementary educators usually teach more than one or two subjects daily. Houndshell (1987, 1984) noted that school systems expect their typical elementary teacher to instruct in as many as a dozen subjects, and to teach all the subjects skillfully. Logically, if teachers are responsible for multiple content areas, they will develop subject area preferences. Regrettably, science is not a preferred subject of most elementary educators (Swartz, 1987; Houndshell, 1984). Perhaps even worse, classroom teachers not only do not like to teach science, but typically feel such indifference to science instruction that they may not even attempt to teach science at all. This empirical evidence supports the existence of what Swartz (1987) called the reluctant science teacher. Houndshell (1984) surveyed approximately 500 elementary teachers to determine their subject preferences. The results of this study suggest that elementary teachers prefer to study and teach English, and to teach math. A preference for science was indicated by only 10% of those educators questioned. At the very least, this broad distaste for science and science education translates into an indifference that can be perceived by the students.

Exemplary, Elementary Science Teachers

The collected pedagogical wisdom of the ages traditionally has dictated that elementary school children will be taught by a single, state certified, elementary teacher in a self-contained classroom. This ubiquitous attitude assumes that all elementary teachers have attained at least minimum competence in both pedagogy, and numerous subject specific content areas. If one includes recent curriculum additions such as Family Life (sex education) and Values Clarification then the typical elementary teacher could be responsible for over a dozen, separate, specific subject areas and the unique methodological strategies for each distinct subject. With the wide array of subjects taught - - from skills in math to concepts in social development - - teachers naturally develop expertise in and preferences for specified content areas of instruction.

When compared to earlier data complied on all teachers by Weiss (1978) Penick, Yager, and Bonnstetter (1986) found that teachers in exemplary science programs (a) are older and have taught longer, (b) have hours and degrees beyond the Bachelor's, (c) stress process approach science, (d) feel greater enthusiasm for science now than when they started teaching, (e) lecture less than teachers overall, (f) attend and make presentations at professional meetings, (g) put in far more than minimal time, and (h) have high expectations for themselves and their students. In summation, these researchers contend that exemplary science teachers "are the antithesis of burnout and perfect examples of excitement, enthusiasm, and professionalism." (p. 20)

Tobin and Fraser's (1990) work in Australia compared exemplary and non-exemplary science teachers in elementary, middle, and high school. The analysis of this study defined four major themes that distinguish the exemplary from the non-exemplary science teacher. Exemplary science

teachers (a) use effective managerial practices, (b) engage students in the learning task, (c) monitor students throughout the lesson, and (d) maintain a favorable classroom environment.

Methodology

All observations for this research were made during the Spring of 1994. Six exemplary fifth grade teachers from six different public schools in two adjacent East Tennessee county school systems were observed. The school sites chosen represented a broad spectrum of the socioeconomic status of the communities in which they were located.

Each teacher was observed six different times. Three of the observations were of science classes; three of another subject chosen by the teacher. At the end of all observations the educator was given a questionnaire and interviewed by the researcher. Pseudonyms were assigned to all participants. The identity of all participants in this study is confidential (see Chart A).

Chart A

FRAMEWORK OF OBSERVATIONS

Teacher	Preferred Subject	Non-Preferred Subject
Sally	Science	Lang. Arts
	Science	Lang. Arts
	Science	Lang Arts
Sebrina	Science	Mathematics
	Science	Mathematics
	Science	Mathematics
Silvia	Science	Mathematics
	Science	Mathematics
	Science	Mathematics
Steven	Science	Mathematics
	Science	Mathematics
	Science	Mathematics
Martha	Mathematics	Science
	Mathematics	Science
	Mathematics	Science
Melissa	Mathematics	Science
	Mathematics	Science
	Mathematics	Science

Identification and Nomination of Subjects

From the onset of this research the objective identification and nomination of exemplary teachers was recognized as a problematic challenge. The educational community's ambiguous positions on teacher evaluation procedures confounded the initial selection of an existing procedure that could identify the exemplary teacher. Could current evaluation procedures, either in-house or state mandated, be the gauge to establish the criterion for teacher excellence that this research

demanded? After careful consideration all present evaluation procedures were eliminated. Positive, internal evaluations were not appraised as a valid indicator of exemplary teaching practice because (notwithstanding many notable exceptions) official, in-house, teacher evaluations are notoriously subjective, and/or politically motivated. The quality of teachers selected using this criterion could not have been assured. Therefore, internal evaluation was eliminated from consideration.

The state mandated evaluation was also not considered a valid indicator of exemplary teaching practice. Although originally designed by the Tennessee Department of Education to help eliminate the subjectivity that is inherent in internal, teacher evaluations, this external evaluation procedure of the state of Tennessee- - The Career Ladder Program - - also was excluded from consideration as an identification technique due to the lack of empirical studies on the validity and reliability of this evaluation process.

Blind Cross-Nomination Procedure

Due to the limitations and inadequacies of these contemporary evaluation models an original approach to the selection of the subjects was justifiably essential. To reduce subjective opinion and bureaucratic instrumentation in the requested identification of the exemplary teachers an original, blind, cross-nomination approach was designed to identify the subjects. The protocol for this procedure was as follows:

(1) Nominations for exemplary teachers were requested from sources outside the physical school environment (i.e., supervisors, central office personnel, professors). This list of teachers was titled STAGE I

(2) A list of STAGE I nominees with their schools' and principals' name were compiled.

(3) From the STAGE I list the nominees were divided into two groups. GROUP M

included those teachers who outside sources nominated as excellent science teachers, and GROUP L included those teachers who outside sources nominated for any subject other than science.

(4) To ensure an eclectic group the nominees were given priority based on the gender indication probability of the first name, and the social-economic profile of the nominees' school. Because the ethnic background of the nominees was an unknown quality at this point, no priority weighting could be assigned for this variable.

(e) The school site Principal of each STAGE I nominee was contacted. (To cross-check the validity of the nomination of the specific teacher the principal was NOT informed that one of her/his teachers had already been nominated.)

(f) Principals were asked if they had an exemplary fifth grade teacher that should be included in the study. If the principal specifically (by name) nominated the teacher on the STAGE I list then that teacher was placed on the STAGE II list. If a Stage I teacher's name was not specifically mentioned by the principal, then that teacher was removed from consideration in the study.

(g) The teachers on the STAGE II list were contacted and asked to participate in the study. All teachers were volunteers.

Procedures

Data were collected using four separate procedures for this study. During classroom observations (a) audio tape records were made and (b) field notes were taken. During a post-observation meeting (c) a questionnaire was completed by each teacher and (d) an interview was conducted.

Descriptions of the Subjects

To assure the anonymity of the six exemplary teachers who agreed to participate in this research, pseudonyms were arbitrary assigned to each of the participating teachers. As a mnemonic device to aid both the researcher and the reader all teachers who preferred *science* were given pseudonyms beginning with "*S*": *S*ally, Sabrina, *S*ilvia, and *S*teven. The teachers who did not prefer to teach science were given pseudonyms beginning with "*M*": *M*artha and *M*elissa (see Chart A). These names were fictitious and randomly selected. They were not intended to be associated with any person either living or dead.

The School Sites

The utilization of two different school systems provided demographically diverse settings for the study. All participants in this research taught in public, elementary schools in East Tennessee. Each school had 3 to 5 classes in each grade. The six school sites in which the exemplary teachers worked drew students from many different backgrounds: (a) One of the schools served an upper middle class suburb, (b) two schools served students from lower SES areas, (c) one school served a rural farming community, (d) one school served as the only elementary school for a small incorporated town, and (e) one school served students from a economically mixed area --serving both a very affluent neighborhood and a blue collar neighborhood.

The Teacher's Classroom Assignments

Each teacher was responsible for the instruction of multiple subjects to heterogeneous groupings of fifth grade students. Four of the teachers taught all subjects to a self-contained classroom of approximately 25 students. Two teachers taught in a semi-departmentalized situation

which involved pairing classes and/or grades, and rotating students with another teacher.

Results

First, to state the obvious - - all of the teachers who participated in this study exhibited excellent pedagogical skills across all subject areas observed. This finding is consistent with Gerber's (1992) research on exemplary teachers. She found that exemplary teachers consistently possessed a theoretically based philosophy and an extensive knowledge of pedagogy. The six exemplary teachers observed in this study were no exception to this finding. Each teacher exhibited excellent classroom management, followed the principals of the Tennessee Instructional Model. had superior classroom discipline, and modified lessons to meet the needs of the students.

The exemplary teachers did exhibit differences in their instructional methods, however. Some of the instructional variations between the preferred subject and non-preferred subject of the teacher were replicated across several of the instructors. Some of the variations, however, were unique to a particular teacher..

Comparisons Between Preferred and Non- Preferred Subjects

This section was originally intended to report the analysis of the differences between the science instruction of exemplary fifth grade teachers who preferred and did not prefer to teach *science*. After analyzing the data, however, the variations that were noted in subject preference instruction were found to be consistent across all of the observed subjects and not unique to science. Based on the consistency of these data across the curriculum, this section was expanded to include preferred and non-preferred subject methodological differences in all of the disciplines that were observed.

Based on the sample of the exemplary fifth grade teachers observed for this research there are qualitative and quantitative differences in the ways in which an exemplary fifth grade teacher will instruct a preferred subject. A written analysis of Table A indicated that:

1) The instructors' preferred subjects are rarely teacher centered, while the instructors' non-preferred subjects will not be student centered.

2) Most teachers' preferred subject lessons are seldom quiet, while the teachers' non-preferred subjects are almost never noisy.

3) The teachers' preferred subjects have connections to the students' real lives, while the teachers' non-preferred subjects may not be connected to the students' real life at all.

4) Teachers used far more paper in their non-preferred subjects.

5) Instructors utilized manipulatives more in preferred subjects.

6) The textbook is used more often in teachers' non- preferred subjects than in teacher's preferred subjects.

Table A

INSTRUCTIONAL STRATEGIES OF EXEMPLARY FIFTH GRADE TEACHERS: IN PREFERRED AND NON-PREFERRED SUBJECTS

Preferred Subject ~~Non-preferred Subject~~

Instructional Center			Noise Level			Connections with Real Life		
Teacher	Mixed	Student	Quiet	Moderate	Loud	0	1-3	>3
3	8	7	3	11	4	0	5	13
13	5	0	8	9	1	5	11	2

Paper	Manipulatives		Textbook	
# of Sheets Used in All 18 Lessons	Yes	No	Used	Not Used
13.5	14	4	2	16
43.5	7	11	15	3

Discussion

Exemplary science teachers (Penick, Yager, & Bonstetter, 1986; Tobin & Fraser, 1990) have been described as well organized, motivated professionals who have high expectations for themselves and their students. The results of this study concurs with these previous findings and adds insight into the strategies used by the exemplary teacher.

Non-Preferred Subject Anxiety and Preferred Subject Confidence

The exemplary, elementary teachers who did not prefer to teach science exhibited characteristics that reflected their anxiety in subject area knowledge which impeded their

ability to teach effectively. The science lesson became secondary to the minutiae mandated by the science expert in the classroom - - the textbook. Detail, definition, and drill dictated the non-preferred science teachers lesson. The subject, science, became a static, motionless subject; and the reluctant authority, the teacher, became a drill instructor.

On the other hand, the exemplary, elementary teachers who preferred to teach science exhibited characteristics that reflected their confidence in both their subject area knowledge and their pedagogical expertise. The science lessons of these teachers were not paper and textbook centered but relied heavily on manipulatives, laboratory experiments, and connections with the students actual lives. The exploration of concepts of science replaced word definitions and fill in the blank worksheets. These teachers often learned with their students and did not pedantically discuss the results of experiments with their students, but rather facilitated inquiry through reflective mentoring.

Control of Students and Self-Control by Students

Control became a central issue in the non-preferred science lessons of the exemplary teachers. The instruction in these science lessons focused on the teacher both visually and auditorially with little haptic or kinesthetic involvement by the students. Because of this unspoken law that all knowledge poured forth from the teacher\textbook little or no verbal interaction took place between the students. Those students who did make comments to their peers concerning the science lesson were considered off task and

reprimanded by the teacher. The teacher held tight control of the student's behavior.

In the science preferred teacher's classroom the students exhibited self-control of their own behavior. This transfer of control was crucial because the students were visually, auditorially, haptically, and kinesthetically involved in the discovery of scientific principles through discovery and experimentation. The teacher was too engaged as the facilitator of learning to individuals and small groups to be the keeper of the keys of discipline. The students exhibited self-control by becoming responsible for their own learning and their own behavior during the science lesson.

Sterile Example and Real Life Analogy

The strategy that will have the most significant long term effect on the student's retention of knowledge was the difference in the use of literal and constructive language between the science preferred and science non-preferred teachers. The science non-preferred teachers' instruction contained little or no connections to their students actual lives. The non-preferred science instruction overwhelmingly contained only the sterile, generic examples that were found in the teacher's editions of the textbook. Few connections were made between the science facts discussed and the students actual lives. The science preferred teacher, on the other hand, not only pulled in concrete examples from the students real lives, they also created novel analogies between the scientific concepts being discussed and the student's lives.

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